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THE EVOLUTION OF THE CEREUS.

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WITHIN late years many remarkable discoveries have been made of value to the arts and sciences, by the aid and use of the camera. Some of these discoveries were accidental; others again were arrived at only after a long series of experiments. Notable among the latter are the photographs of animal locomotion, and others, which so completely revolutionized many of the old theories and ideas which had held sway for centuries.

One of the latest applications and uses of the camera has been the successful attempt made to show visibly the growth and development of plant life, and in the experiments hereafter described it will be seen that marked growth, expansion or development can be shown on the sensitive plate, in an almost incredibly short space of time.

These experiments came about in the following manner: Several years ago the attention of the writer was called to the blooming of the ordinary Night-blooming Cactus, and the development of the bud and flower; this caused a desire for further and more thorough information on the subject. For this purpose a variety of the Cereus family, which at that time was ready to flower, was obtained, and the subsequent development and unfolding of the bud into a full-blown flower carefully observed and studied.

One of the most wonderful phenomena in nature, is how the vital force is stored in plants; how for months the plant lies dormant, without giving forth any sign of life or activity; yet when the time comes, the development of the bud, leaf or flower as the case may be, proceeds with certainty and rapidity. This fact is, perhaps, more beautifully instanced in some of the "Cactacea" than any other genus of plant life.

Where this hidden energy and life is stored or what force or spark loosens the bonds, and sets the mechanism of the plant in motion, and causes the collapse from the moment when the zenith is reached, or the mysterious power is expended, is as yet an unsolved problem.

Whether this vital force, which so wonderfully causes the rapid development of the bud, with the accompanying straining and tremor of the fibres, from its base to the very point,—action which is equalled only by the nervous twitchings of the

animal organism,—together with the expansion and increase of the cellular tissue of the plant, is the result of some chemical agents or properties, stored somewhere within the cellular system of the hard, dry, and often shrunken stem, or is absorbed from the dry, sandy soil, by the scanty rootlets of the plant, and, if so, whether it is by the aid or action of light, air, heat or electricity that the unseen mechanism of the plant is set in motion, no one has yet been able to discover.

Arguments have been set forth tending to show that the length of all life in the universe was regulated by the rapidity of the growth of the subject—the quicker the development, the shorter the existence. Many are the theories which have been advanced on this and kindred subjects, but all without arriving at any definite conclusion.

The study of these marvelous functions of the plant organism stimulated the desire for further investigation, and led to the determination—if a similar opportunity should offer in the future—to make a series of measurements, and capture, if possible, on the sensitive gelatine plate in the camera, the successive stages of development and growth of this remarkable member of the plant kingdom.

In May of the present year two specimens of the *Cereus MacDonaldiæ* (Hook) coming in bud were available for experimental purposes, the first a young, vigorous plant, showing indications of three buds, the other an older plant with two buds.

It may not be amiss here to describe the plant selected.

The plant was discovered by General MacDonald in the wilds of Honduras, during the later "forties" of the present century; cuttings of the plant were sent by him to England, and named in honor of his wife.

The cuttings sent to the Kew Gardens rooted and flourished, and in 1851, during the great exhibition in London, bloomed for the first time in Europe, the flower, from its size and beauty, attracting much attention and admiration from all who had the good fortune to witness the expanding of the petals.

Linnæus, called the father of botany, knew but comparatively few of the plants known to us as the Cereus; it was Haworth who first considered the distinctive characteristics by which they varied from the Cactus variety important enough to branch them off and group them in a new and separate variety, viz. "The Genus Cereus."

The name itself is derived from the Latin and denotes a wax taper (*Wachsfackel, Wachskerze*), and was selected with reference to the use of the porous stalks of some varieties of this plant family by the Indians, by whom they were soaked in wax, gums or other inflammable substances, and used as torches; in German they are called Fackeldistel or Kerzen-Cactus.

The plant itself is rather unattractive. The main stem, about the thickness of a man's thumb, sends out rambling, far-reaching, climbing limbs or branches. These are about the thickness of a little finger, five to seven cornered, almost round, with dull, irregular edges, having, at irregular intervals, small, rough knots, or protuberances, covered with bunches of fine prickles or thorns; the color of the matured growth is a dark, dull green. The importance of the plant, which unfortunately is a shy bloomer, consists wholly in the flower, which, when fully developed, is about fourteen inches in diameter, and appears during the month of June.

The development of the bud at first is very slow, being merely a small protuberance on the stem about the size of a pea. After a certain period the bud becomes in size and appearance like a hazel-nut. The development is then exceedingly rapid, as will be shown by the accompanying plates; the total length of the bud and stem, just before the final expansion, is about equal to the diameter of the full blown flower.

The base of the Perigyon tube or stem (*Perigon röhre*), is of bulbous shape, the tube proper, cylindrical, of a brown-green color, the outer sepals orange-yellow; inner sepals, yellow, all curved backwards; the whole form of the flower being liliaceous (*lillienformig*); petals, white, spattle-shaped (*spatelformig*), the numerous stamens about seven inches long, recurved with sulphur-colored yellow anthers; pistil, white, truncated and extended beyond the stamens, with stigma radiating in ten or twelve directions, the extreme points being a very light yellow.

For the better illustration we will designate the plant with three buds as "No. A," the other one "B," the buds respectively as I., II., III., IV., V.

As soon as it was found that the two plants above mentioned were available, preparations were at once made, as well as the limited photographic resources and knowledge of the operator would permit, to make the exposures at intervals of fifteen minutes, as soon as the development of the bud was fairly under way.

It may be well to state at this point, that in these exposures no special care was taken for the purpose of making an artistic picture; the only object in view being to obtain a set of progressive plates of the gradual evolution of the bud into a flower.

The accompanying illustration of this article is a reduction of twelve of the negatives hereafter described, these were selected merely with the view of giving a general comprehensive idea of the results obtained.

The complete set of thirty-six negatives has been printed and mounted; lantern slides of the series have also been prepared, for the purpose of further comparison. The numbers given in the text refer to this complete set of pictures.

Plates 1 to 4, of this series, had been taken May 29 and 30th, for the purpose of showing the general position of the buds and characteristics of the plants. On the afternoon of the last named date, when there seemed to be every indication of an opening of the bud, the camera was placed in a favorable position and screwed down securely. In this position plates 5 to 10 were taken of bud I., specimen "A," at the interval of fifteen minutes; the first of these exposures being made at 5 o'clock P. M., the bud then showing the first marked signs of expansion. Plate 6, made at 5.30, shows an expansion of about three inches,—plates 7, 8 and 9 show expansion of 2½, 3½, 3½ inches respectively, during the intervals of fifteen minutes which intervened between the exposures. The plates used in these experiments up to this stage of the investigation, were the ordinary Carbutt B—16 sens.—as sold by all photo. stock dealers. Plates 9 and 11 were "Special Orthochromatic" (25) from the same maker. The superiority of these plates over the others for this work was clearly demonstrated. The latter plate (11) was made at 7.30, by the aid of Magnesium or "Blitz-pulver." 35 gr. of the compound were used for the purpose. The picture shows this monarch of its genera in all its glory, the flower being fully expanded, the sepals recurved, and measuring a trifle over fourteen inches in diameter.

Plate 12, also made by the aid of the "Magnesium flash" just before the break of day (4 A. M., May 31st), shows the flower in a state of collapse, after its mission had been fulfilled, and the mysterious vital force or power had been expended; the drooping flower measured about two inches longer than the bud on plate 6, at 5.30 P. M., showing that there had been a considerable increase of fibre-cellular tissue and solid matter during the time in question.

It had been the intention of the experimentor to continue the exposures by the aid of the magnesium, at the same intervals, after plate 11 was made, and thus showing the various stages through which the flower passed, until it reached the final collapse; but as objection was made, in the fear that the smoke or gases evolved from the magnesium might injure the other plants in the greenhouse, the writer had to content himself with the few which he was permitted to make, and are here described.

Buds II. and III. also on specimen "A," developed on the following day, June 1st, 1888. Unfortunately the writer was prevented by other business from observing the early stages of their development. On arriving home at 6.30 P. M., it was found, much to the chagrin of the observer, that both flowers were in full bloom. Plate 13, of bud II. was made with as little delay as possible, at 7 P. M.

Plate 14, showing both flowers, 2 and 3, in all their beauty, was made at 7.20 P. M. Both of these plates, unfortunately, were slightly light-struck; caused by a defective plate-holder. By this time the twilight had set in, and became too weak for further exposures. An attempt was now made to obtain a full front view of bud 2, with the aid of "Blitz-pulver;" the result of this was plate 15, made about 7.45, the grand picture shown in the accompanying illustration. The last four plates were the "Carbutt Special" (25).

It will be noticed that in plates 1 and 4, bud IV., on specimen "B," was no larger than an ordinary hazel-nut. The bud showed but little sign of life during this time, until about the latter part of the week, June 7th, when the bud had expanded to 3¼ inches in length, and at 5 P. M. the first plate, No. 16, of this series was made. Careful measurements were now made of the growth every night and morning, with the curious result, showing that, although the plant is what is called a night-bloomer, all the growth and development was between sunrise and sunset, there being absolutely not a particle of growth registered during the night. Plates 17 to 23, taken at an interval of twenty-four hours (5 P. M.), show the daily growth to have been ⅜, 15-16, 13-16, 1¼, 1¼, 1, ⅞, 1, and 1¾ inches respectively.

Exposures 16 to 22, June 7th to 13th, were made with a camera in the same position, the lens being about seventeen inches from the bud. These plates show the growth and gradual inclination of the bud. June 14th, the spiral motion or revolution of the bud, preparatory to the final expansion of the flower, commenced. The camera was here changed so as to bear upon the bud as it turned. Plate 23 was made at 3 P. m., plate 24 at 4 P. M. The bud had now reached a total length of ten inches, viz., the bud proper, 4¼; the stem or tube, 4¼; the bulbous base, 1½ inches. In the meantime the sky had become overcast, dark and cloudy to so great an extent, that the experiments for the day were reluctantly abandoned. June 15th, at 6 A. M., plate 25 was made, from a point opposite from which the other views were taken. Plate 26 was made at 3.15 P. M. of the same day, the bud having now reached the proper position for its final evolution.

After the turn of the bud was complete, the camera was re-adjusted so as to bring the bud within the scope of its focus; on the following day, June 16th, the bud curved a trifle upwards, and gave every inclination of opening about sunset.

At 3.45 P. M., plate 28 was made. The total length of the bloom had by this time increased to 12¾ inches, being a growth of 1¾ inches within the last twenty-four hours; the bud proper had grown fully an inch within the last forty-eight hours, —*vide* plate 24. To add to the difficulties which beset the operator, the afternoon was destined to be dark and showery, the light proving almost useless for making photographic exposures.

Notwithstanding this great drawback, exposure 29 was made at 5.45 P. M., the plant showing great reluctance or lack of force to reach the final culmination; although this plate shows a considerable swelling of the bud, the slow and retarded development made it very unsatisfactory for the experiment. Shortly after 6 P. M., the position of the camera was again slightly changed for the last time, to suit the droop of the unfolding flower. This change brought the lens to within twelve inches of the flower. The weather was now very dark, a heavy shower falling. At 6.30 P. M, exposure No. 30 was made on a Carbutt "B," lasting thirty seconds, with a medium stop. At the expiration of fifteen minutes, plate 31 was made (6.45 P. M.), the shower by this time had passed, and it became a little lighter. Exposure 32 was now made on a special 25, with medium stop (7.00 P. M.), lasting about twelve seconds. The result of this exposure was a fine, soft plate. Notwithstanding the breaking of another heavy shower, the 33d was promptly exposed at 7.15 P. for fifteen seconds, using a larger stop. Plate 34 was made 7.30 P. M. under the same adverse circumstances; the time here was increased to about twenty-five to thirty seconds. The light by this time had almost totally failed. However, at 7.45 P. M. the 35th plate was exposed, but without any hope of success. The attempt was made with an open diaphram, and the cap was kept off about a minute.

For some unknown cause, presumably the atmospheric condition, the bud did not expand or develop into a complete flower, consequently the experiment from which so much had been expected by the sanguine observer, proved a partial failure, after half an hour had elapsed from the time when the plate last described had been made. Exposure number 36 (Carbutt Orthochromatic 25) was made by the aid of thirty-five grains of "Blitz-pulver." This plate was, unfortunately, partly spoiled after its development. Further investigation was now abandoned in the hope of better success in the development of the fifth and last bud. Here the writer was again doomed to disappointment. The bud was found next morning broken off on the bench beside the stem.

After the plates were developed and examined it was found, much to the surprise of the experimenter, that some of these plates, notably 24, 26, 28, 29, 32, 33, 34 and 35 had perceptibly registered the growth and expansion of the sepals, and that even the actual tremor of the flower in its eagerness for development was shown on the sensitive plate in a truly wonderful manner within the time of exposure, lasting in most cases from ten to thirty seconds. On plate 35, where the exposure lasted about one minute, an examination will plainly show the movement or growth of every sepal or petal in the flower.

Special attention is called to plates 33 and 34 in the accompanying illustration.

It will be observed that although greatly reduced, the outward growth or movement of the pistil is plainly visible in the picture. A comparison of the position of the inner and outer sepals in these two representative plates clearly shows the changes and evolution of the bursting bud within the interval of fifteen minutes, while the registered growth of the pistil on one plate (33) was recorded within almost less then that number of seconds. This fact alone is a great triumph for photography, and the discovery of the possibility of registering the natural growth or development of plant life by the aid of sensitive gelatine plate in the camera within twenty seconds of time, certainly opens a wide field for future investigation and discoveries.

It is to be hoped that these experiments, crude and unsatisfactory as they are, may yet be found important enough to attract the attention of other and abler students in this line of research, and result in the further development of the great possibilities of the camera in this field of biology, and thus add to our stock of knowledge by unfolding the mysteries and secrets of the great book of nature so wonderfully instanced in the Evolution of the Cereus.

JULIUS F. SACHSE.

Leopard, Chester Co., Pa.

PHOTOGRAPHIC INCONGRUITIES.

SO vast has been the development of the art of photography of late years, that it is now hardly possible for any one class of reading-matter to appeal to all who may be interested in the art. When we think of the large numbers of unselfish experimentalists and students, whose only aim is to perfect the different processes or to discover new ones, as well as of those who may be compelled to make use of the art in an entirely mechanical manner, we can well imagine that they would deem our efforts to improve the good taste of the craft incongruous indeed, so far as they were concerned.

Not allowing ourselves to be discouraged by such considerations, however, we ask the attention of our readers to some faults, in the prevailing styles of photographic work, which might easily be avoided by exercising a little taste and good judgment. First of all, in reviewing the work made in such quantities by the small-sized concealed or detective cameras, we find in it few qualities that raise it above the level of a very low mediocrity. It looks as if the owners of the cameras had simply tried to see how many plates they could possibly expose, quite irrespective of good or bad light, or of anything even approaching to careful choice of subject or position for the camera. It never seems to occur to those who make work of this character, that instantaneous photography, so far from being the child's play or amusement which they seem to think it is, is in reality a difficult branch of the art, and one which will infallibly expose unskilfulness on the operator's part. This is true for work made by the small cameras themselves, but it is seen to be far more so in the case of enlargements from the small negatives, which in many instances are abominable eyesores, both in the photographic and in the pictorial senses. If asked to mention the incongruities seen in this kind of work, we should have to decline, owing to want of space.

The excuse would doubtless be given that, having no finder, and carrying the

camera in the hand or about his person, the operator cannot tell just what he is doing. Precisely so! and therefore we advocate the use of a proper detective camera, mounted with a finder, so that the exposing of the plates may be intelligently done.

Our efforts to make some of the principles of practical perspective clear to our readers in our last two numbers, included some instances of disagreeable faults in this particular, which were often to be seen, particularly in architectural photography. In landscape, while the perspective is generally more correctly given, we find faults in exposure more common, as well as bad composition; such, for instance, as straight trees, mountain ranges, and other lines repeating the boundary lines of the picture or even each other in the most offensive manner. Under-exposure of the foreground and over-action of distant brilliantly-lighted objects is still a common defect seen in landscape photographs, and is not to be gotten rid of simply by using this or that brand of plate, and the last new thing in modified developers or special ortho-chromatic plates or color screens.

That many landscapes will be greatly improved by the judicious introduction of one or more figures need hardly be said. But it is by no means an easy thing to make the introduced figures suit the landscape. It might seem a platitude for us to speak of the suitableness of nicely dressed ladies and gentlemen to a fine, well-cropped lawn, with tennis-bats or croquet-mallets in the picture. A figure of a roughly-dressed farmer driving a team of oxen or a bare-footed boy with a fishing pole and basket,would be as much out of place on the lawn as the dandies and belles would be in a lonely, leafy forest road, or on an elm-shaded beach by the river side. And yet how very often we see instances of just this latter incongruity, now that the camera has become a plaything in the hands of wealthy and leisure young ladies and gentlemen.

So much for landscapes. But when we turn to amateur efforts in portraiture, things are very different. Many charming portraits and groups are made in private houses with home surroundings, all of which contribute to the general *sansgene* of the picture. The sitter is not hampered by the surroundings of the regular portrait gallery, and feels at ease. Thus however deficient in technical excellence the amateur's pictures may be, they often compensate for the defect in also being quite free from such incongruities as we have alluded to.

There is a wide-spread and damning defect in many of the more ambitious of modern portraits which, as an incongruity of the very worst kind, we cannot pass over in silence. This is *under-exposure, and large patches of black shadows without detail in drapery*. It is becoming a rare thing comparatively to see good body in the shadows of darkly clothed sitters, together with absence of solarization and flatness in the face. That there are honorable exceptions to this assertion goes without saying; but we are speaking of average work. Careful lighting and choice of plates and chemicals are just as important in these times as they were in the older days of collodion, particularly for such subjects.

Another fault in portraiture that has recently made its appearance is an unskilful use of the top-light, which creates over-action on the hair, (particularly when of a light color), so that sometimes the proper outline is lost against the background. Portraits of ladies and actresses with the hair bound up with the Grecian fillet, if posed before a light-colored background, will often show this very ugly defect. Another

defect, perhaps not so common, is the trimming of the print so that in profile portraits too little space is left before the face and too much in the rear.

We have always considered the choice of a suitable background for the sitter as a very important matter. Our older readers will remember the clumsy attempts at landscape scenes in backgrounds so much in vogue in former times. Impossible views of lakes, with sugar-loaf mountains crowned by castles resembling those used in playing chess, and groves of cedar trees designed like cumulus clouds, the two often interlacing fraternally in the sky of the background. And we regret to say that remains of these vulgar eyesores still linger in some of our galleries, and may be seen behind a figure, such as a girl dressed with all the *naïvété* of a peasant, reclining on an elaborately carved parlor sofa or chair, the sitter's eyes being ostentatiously directed away from the landscape.

Portraiture out of doors offers as a rule considerable difficulty as regards the background. It is too common a custom to simply seat the sitter in a chair and focus upon the face, leaving objects in the rear to take care of themselves. The pictures will thus often appear very distinct, but only because of their contrast with objects entirely blurred from want of focusing. Perhaps nothing is more pleasing as a background for out-door portraits than the wall of a building covered with some climbing plant, such as ivy or creeper. Occasionally a good effect may be obtained by posing the figure in a standing position before the steps of a piazza leading to the open doorway of a house. The head will thus be relieved against the deep shadow in the doorway, while the dress will find contrast with the better lighted objects below.

ELLERSLIE WALLACE.

THE HYDROQUINONE QUESTION.

TO determine whether pyro or hydroquinone is the better developing agent, or whether both alike are good, was the object of our comparative experiments.

Plates were exposed and then cut in halves, one-half being subject to a pyro developer, the other to a hydroquinone developer. We succeeded in producing negatives on each half, which, in quality, color, density, etc., it was impossible to distinguish from one another. The two halves when joined look like portions of one negative developed under a single developer. The method pursued and the deductions may be of interest to those who are anxious to know the relative merits of the two agents, but we think the question of preference will still remain on debatable ground.

The pyro developer employed is constituted as follows: 5 grains pyrogallic acid, 11 grains sal soda, 33 grains sulphite soda, to each ounce of water. The hydroquinone is composed of: hydroquinone, 2 grains; carbonate of potassa, 10 grains; sulphite soda, 10 grains; water, 1 ounce.

The small proportion of hydroquinone was used at the suggestion of Mr. John Cassebaum, who has produced excellent hydroquinone developed negatives.

We agree with him in diminishing the amount from that recommended by the formulæ. The results are better, and the negative more harmonious, than when a slight excess of the hydroquinone is employed. In our trials harshness followed from

too large a portion of the hydroquinone. However, we do not find that the large amount of sulphite of soda he uses is necessary,—indeed, we are inclined to believe that it retards the action. Ten grains of sulphite to each grain of hydroquinone, as recommended in most formulæ, is likely to cause protracted development. The sulphite is added to keep the hydroquinone solution clear, but it may be entirely dispensed with or greatly reduced without any injury to the developer—indeed, rather to its advantage. As one of the French experimenters has shown, the discoloration is due to improper solution of the hydroquinone in the water;—if a particle remains undissolved it forms a nucleus of discoloration which soon contaminates the whole mass. We thoroughly dissolve the hydroquinone, and add, only by way of precaution, five grains of sulphite to the ounce of hydroquinone. Of course any bromides are useless. We also add a few drops of sulphuric acid, with a view of keeping the solution colorless.

It will be seen that the above formula is a one-solution developer. With plates fully timed it produced results, as we have said, not to be distinguished from pyro-developed plates. The pyro, however, was a little more energetic in its action, the negative from the half plate developed with it gaining density some time before the hydroquinone half. With undertimed plates the pyro had the advantage—the results were less harsh than with hydroquinone.

In fully timed plates hydroquinone seems to yield, more easily than pyro, a pleasing contrast of light and shade,—that is, it requires less care in the development to secure brilliancy. We were enabled to develop five 3¼ x 4¼ plates in the same hydroquinone solution before discoloration set in. We discontinued its further use, but believe that other plates would have developed in it without stain to the film. The limit of clearness of the pyro was to three plates of the same size.

Concerning the question of cheapness of price the two developers are on a par. The hydroquinone has the advantage of keeping the fingers clean. The stain produced by hydroquinone upon the film, when a plate is allowed to lie in it for a considerable time, is not so adactinic as that produced by pyro.

A pyro stained plate, as is well known, is very slow in printing, the color being yellow, and the resultant print often flat. Hydroquinone stain is always much paler, and does not seem to interfere materially with the printing qualities of the negative. Hydroquinone sometimes causes a greenish opalescent appearance of the film which is in no way perceptible by transmitted light; and in no way injures the negative. This greenish film is more liable to occur when excess of hydroquinone is used in the developer. We would recommend therefore, in conclusion, not to go beyond two grains to the ounce of water, and to diminish the amount of sulphite of soda from that given in the formulæ. One grain of hydroxylamine to every twelve ounces of hydroquinone has been recommended as a preservative. We cannot speak of its action from practical experience.

SURFACES FEEBLY SENSITIVE TO LIGHT.

INTERESTING experiments have been recently made by Mr. J. W. Osborn, of Washington, on the sensitiveness of different surfaces to light, the result of which he has embodied in a paper, the following abstract of which is given in "*Science*."

"In thinking and speaking of substances sensitive to light, photographers and others are apt to remember only the haloid salts of silver, chromic acid, under restraint, acting on organic matter, asphaltum, and a few salts of iron and platinum; which short catalogue does include all the sensitive bodies used in practical photography."

But as every one knows this list may be indefinitely extended (if the degree of sensitiveness be disregarded), and Mr. Osborn has prepared a number of specimens to show such extension in certain directions. "Broadly, he says, the results should not be regarded as new, though in the manner of their preparation and presentation some novelty may be claimed for them."

Three specimens were prepared to show colored commercial paper which had been bleached by light, and which gave, therefore, a negative when exposed under a negative. On other sheets, exposed papers, colored for the purpose with eosine and methyl violet, were shown, and they establish the fact that these colors, under the luminous influence, give rise to colorless compounds.

"The duration of the exposures required to produce these photographic effects," says Mr. Osborn, "is very considerable when the charge is carried to its maximum, varying from twenty to thirty-five hours in direct sunlight, which is the only kind of exposure employed in the experiments. Indications of photo-chemical action are, however, visible in much less time. A piece of eosine paper, exposed under two strips of black lace, showed a faint positive after half an hour; also a piece of methyl violet paper, similarly exposed, showed gradually increasing strength of the positive, after one, two and three hours."

The fact that printing and writing paper become brown by age is familiar to most persons; but that this change is essentially photographic is not common belief. Pieces of newspapers were taken from the New York *Tribune*, Baltimore *Sun* and Washington *Evening Star*, and photographic images were impressed upon them by simple exposure under a dense negative. These papers were subjected to no preparatory treatment, thus establishing the fact that the newspapers we read daily are printed on papers sensitive to light and adapted for the production of positive photographs.

Pieces of white pine wood of different qualities were prepared, upon which photographs were produced by exposures under stencil negatives, made by cutting openings in tin-foil and pressing it into close contact with the surface of the wood by means of a plate of glass properly clamped thereto. The exposure required to produce these photographic images varies from thirty to fifty and sixty hours.

On a piece of poplar the picture was produced in twenty hours, for it seems probable that, of all the woods in common use, poplar is the most sensitive to light, and gives the darkest colors when fully exposed. It seems probable that the darkening of wood, which is very commonly, though rather vaguely attributed to the action of the air, is related to the photographic effect obtainable on printing papers. These

are now hardly to be had without an admixture of wood pulp, and the present inquiry, inasmuch as it proves the phenomena to be strictly photographic, may have a practical bearing if it points to means which shall keep printing paper indefinitely white. The bleaching action of light upon dried leaf is shown by one specimen, and by another the fact that a piece of parchment, though substantially white, becomes a little whiter where the light has acted. So far as this goes it would tend to show that the yellowing of parchment by age is not a photo-chemical process. The parchment has a very long exposure.

"As connected with this general subject," continues Mr. Osborn, "I would call to mind the investigations of Mr. Morris Gaffield, of Boston, who established conclusively more than twenty years ago the slow effect of light on colorless glass, in gradually giving it color, sometimes pinkish, and sometimes yellow; the former being apparently due to re-oxidation of the reduced manganese employed to counteract the iron. These changes often require years for their completion.

"Experiments only just completed tend to show that pure cellulose in the fibre of finest filtering paper is not sensitive to light; at least a constant exposure in a horizontal position to diffused and direct sunlight failed in two weeks to produce any perceptible change in color. On the other hand the same filtering paper, colored with picric acid, and similarly exposed for the same time (about one hundred and forty hours of diffused and direct sunlight) gave a coloration as before."

Simultaneously with the above exposures another was made of the same duration and in the same way. This was the presentation of a thin stratum of commercial picric acid or glass to the same illuminator as that already mentioned, under a stencil tinfoil negative and a plate of glass covering the same.

The picric acid was darkened as before, very decidedly, though it would be difficult to exhibit the result, in a satisfactory way, by means of a specimen.

BEST METHODS OF MAKING INSTANTANEOUS PHOTOGRAPHS DURING BOTH DAY AND NIGHT, ILLUSTRATED BY EXPERIMENTS AND PROJECTIONS.

A communication to the American Association for the Advancement of Science.

INSTANTANEOUS photography, by the discovery and introduction of dry plates, has given a great impetus to science in every department. It is now necessary that the investigator in most branches of science should have a practical knowledge of the art. It records his discoveries by a process of nature's engraving that is absolute truth. Any advancement in this art by discovery or application interests all investigators. In a condensed form I will state some of the most important facts in relation to this subject, and exhibit specimens of actual results.

The best lens for taking instantaneous photographs of landscapes and moving objects at a distance of 100 feet and over is a single achromatic lens, with the largest diaphragm that will give good definition, a single achromatic obstructing less light than a double achromatic lens with the same-sized diaphragm and equal focus. As a single achromatic cannot be used for near objects, on account of distortion of the image, a double achromatic lens is absolutely necessary, with the largest diaphragm

that gives good definition. Magnesium in powder, with any substance that will cause rapid combustion, is the best substance known for producing a light for instantaneous photography in dark rooms or at night. Chlorate of potash, gun cotton, sulphide of antimony, picric acid, and other substances, can be used with the magnesium, but I prefer magnesium with one-third its weight of flour of sulphur. This has given me perfect satisfaction, is a safe compound to use, and can be ignited by any burning substance or the electric spark. With the camera six feet from the object, and the flash light two feet back and a little to one side of the camera, 30 grains of magnesium and 10 grains of sulphur, with a reflector behind the flash, will give a good photograph on an ordinary plate of No. 25 sensitometer, or on an orthochromatic plate No. 27. At 12 feet distant, 120 grains of magnesium and 40 grains of sulphur are required. Good photographs can be taken on a 25 sensitometer plate at a distance of 24 feet by flashing 480 grains of magnesium and 100 grains of sulphur. On a 35 sensitometer plate, one half of this quantity is sufficient.

At a distance of six feet, this flash light, I find, is equal in its actinic effects on the plate to the ordinary ribbon magnesium lamp running 30 seconds, with a ribbon one-eighth of an inch in width, and burning 12 inches of ribbon.

At 12 feet distance of camera, the flash light is equal to an exposure with magnesium lamp of two minutes, and burning four feet of ribbon.

At greater distances than 12 feet my experiments of comparison are indefinite. If a white screen is placed on one side of the object, opposite the side on which the flash is made, and a white screen or mirror behind the flash, it improves the illumination and makes the shadows less dense. The same results can be obtained by having on the other side of the camera 15 grains of magnesium and 5 grains of sulphur, and igniting them both at the same time by a spark from a small Ruhmkorff coil. An intervening screen of translucent cloth or paper or ground-glass between the flash and object will also give fine results; but more magnesium is required to be burned, as some of the light is obstructed. Exposures by day, when the time is less than one-tenth of a second, should be made from 11 A. M. to 2 P. M., in clear sunshine. The sensitive plate used for instantaneous work should not be less than 25 sensitometer, and fewer failures will be made with Nos. 30 or 35.

One of the photographs that I will show you is a street view and United States Custom House in Charleston, that I took after the earthquake, at 12 o'clock on September 16, 1886, on a 25 sensitometer plate, with a single achromatic lens and of one-fifteenth diaphragm, clear sunshine; estimated time, one-twentieth of a second, using a metal drop shutter. Another photograph is a street scene in Washington, corner Four-and-a-half street and Pennsylvania avenue, taken at 1 P. M., July 10, 1887, on a 35 sensitometer plate, with a double achromatic lens, *f*, one-twelfth diaphragm, clear sunshine; time, one two-hundredth of a second, using a Prosch shutter. The moving objects in this photograph appear as if at rest in the attitudes seen. Another photograph is one that I took of a snow scene in Washington, corner of Seventh street and Pennsylvania avenue, at 11 A. M., April 1, 1887, on a 25 sensitometer plate, with single achromatic lens and *f* one-fifteenth diaphragm; thin clouds and snowing slightly; estimated time, one-fortieth of a second, using a drop shutter with rubber band accelerator.

The shorter time in which a photograph of moving objects is taken when a good

impression can be obtained on a plate, the more perfect the photograph. Professor Muybridge has taken photographs of moving objects in the one five-thousandth part of a second.

Distance and velocity of moving objects must be taken into account in successful instantaneous photography. With a lens of five-inch focus, and objects 100 feet distant, moving at ten miles per hour, the image on the sensitive plate will change seventy-three one-hundredths of an inch in one second. A railroad train moving at the rate of 40 miles per hour, at the distance of 400 feet, or a man walking two and one-half miles per hour, at the distance of 25 feet, will change the image on the plate the same amount in the same time. The change of over one-half an inch will make a mixed blur of objects; but if the time is reduced to the one two-hundredth of a second, the image will then only change the .0036 of an inch, and this change of less than the four-thousandth of an inch will give a distinct image. The actual motion of a railroad train at 40 miles per hour is 58 feet and 8 inches per second, of a street car at ten miles per hour is 14 feet and 8 inches, and of a man walking at the rate of two and a-half miles per hour is 3 feet and 8 inches per second.

The method of calculating the change of image on the plate is the same as the lever, the long arm representing the distance from the moving object to the lens, and the short arm the focus of the lens. The photograph of a lightning flash can be taken at night by adjusting the camera for distant objects by daylight, and then at night pointing the camera with the cap off toward the thunder cloud and await the flash. A single achromatic lens is the best to use. A good photograph of a lightning flash that I will show you was taken by Prof. C. F. Marvin, of the United States Signal Office, June 19, 1887, at 3 A. M. Taken on a Carbutt plate, No. 24 sensitometer, with double achromatic lens, 10-inch focus, *f*-10 diaphragm. The camera was left open four minutes, during which time several successive perpendicular and horizontal flashes were photographed on the plate.

The exposure was made in Washington, corner of Thirteenth and S streets, N.W. The building photographed on the plate by the lightning flash is Howard University. Good photographs can be taken of the sparks from an induction machine by having quart jars in connection with the prime conductors, and using a short focus lens.

The exhibition of photographs of single sparks, and of several in rapid succession, were taken by myself with a five-inch focus lens and *f*-6 diaphragm on a 25 sensitometer plate.

One photograph, sent me from the United States Training School at Willet's Point, New York Harbor, is that of a mule with his head blown off with a dynamite cartridge, and photograph taken before falling to the earth. Taken with a 16-inch focus lens, *f*-32 diaphragm, on an Eastman plate, sensitometer 22, 2 P. M., sunshine and light clouds. Another photograph, taken by Prof. T. W. Smillie, of the National Museum, Washington, is a mackerel schooner under full sail, taken from the deck of a steamer going in the opposite direction. Lens 16¼-inch focus, diaphragm *f*-16, exposure one one-hundredth of a second, plate sensitometer 25, sunshine, 12 morning. A photograph of base-ball playing, showing balls in the air, was taken by Mr. C. C. Jones, assistant photographer United States Surveys, with a detective camera of six-inch focus, diaphragm *f*-24, at 4.30 P. M., July 15; time, one-fiftieth of a second, plate sensitometer 26.

The sensitive plates used in instantaneous photography, particularly the special orthochromatic, must be changed and developed in the least possible amount of actinic light, or the negative will not be clear and distinct.

The record I have given of the practical experience in instantaneous photography may be of service to many in their scientific investigations.

E. P. HOWLAND.

SOME POINTS IN DEVELOPMENT.

AT this period of the year, when the opening of the Photographic Exhibition usually draws together workers from all directions, who, except at Convention time, rarely foregather, discussions on nice points of practice often arise, and have the benefit of being dealt with by coteries of experts, embracing some of the most experienced hands in the country. Recently there was brought before us a greater variety of opinions than might have been thought possible on the question as to which was the best way of developing a batch of negatives that it might be expected were fairly correctly exposed. It was very quickly to be seen that, like the famous shield in the fable, there were two or more sides to the question. Many of the disputants, holding opposing views, might be equally right according to their standpoints. The most uncommon method, perhaps, was that of a gentleman who always developed a number at once in one dish when working half-plates. As we had the opportunity of observing his mode of operation, it will be interesting, as an item of methods of practical men, here to describe it.

The first step was to place fourteen negatives in a dish, and then to flood them with water, which was allowed to remain for five minutes. While the plates were soaking, the developer was mixed in a large, wide-mouthed, earthenware vessel with a handle, such as can be purchased at any earthenware shop, which struck us as being remarkably useful, though we had never before seen one put to this use. Next, the water was poured off, and the pyro developer poured on, in a solution three grains to the ounce in strength. As the image gradually appeared, and gained in detail and in intensity, a plate was now and then taken out, and when the last one scrutinised appeared to be right, the developer was poured off all at once, to be succeeded, after a slight washing with water, by the hypo solution, freshly mixed for each batch; and the whole were fixed in a very short time. In reply to our query as to how the under- or over-exposed ones were treated, we were told they had "to take their chance—they generally came up about right." Now, granted a sufficiency of dishes for the above described series of operations to follow one another without delay, it would be difficult to imagine a quicker mode of getting through a number of negatives in a short space of time, if only the quality of the pictures came up to the standard.

As to the case in question, we are bound to say, that a very excellent average was shown in the pictures passing through their various manipulations, at the time of our visit. But then arises the query, Can a high average be obtained by such a method of development? It would all depend on the skill, and, perhaps, to some extent, the luck of the operator. If there were very great variations from the correct standard of exposure, few would assert that, apart from the question of modifying the

action by bromide or by alkali, every negative of a batch developed for one uniform time would be of equally suitable printing density. Yet here, as a matter of fact, we saw the process in operation at the studio of a busy professional photographer doing good average work. Our view is, that the best criterion of its merit is to examine a number of negatives of *carte-de-visite* subjects, taken two or four on a plate, with varying exposures. We have noted many such, and one of the two or four was always better than the other, often to a considerable extent.

We may now look at the matter in another aspect—the washing or soaking in water before developing. There is in this the advantage of diminishing the chance of air bubbles attaching to the plates and so marking them; but a considerable loss of time is involved by this method with, in our opinion, and we believe that of the majority of photographers, not the slightest advantage. Further, some plates are strongly repellent to the developer after they have been first moistened with water, and so would have a tendency to marbling. Then, again, in a given time, equal density would be obtained with a much weaker developer when the plates were put into it direct; thus the time required as above for the completion of development with a three-grain solution would have sufficed, when water had not first been used, with one of two-grain strength.

There remains to consider the question of the addition of alkali or other modifications of the developer to meet the needs of variations in the exposure. But there is here less ground for criticism than might at first be thought. A photographer in the habit of exposing large numbers of plates daily, naturally attains considerable skill in gauging exposures, and when he developes he would, as a matter of course, *cæteris paribus*, use a solution which would do its work in the shortest time. Obviously, a maximum of ammonia would then be used at the outset (though some will affirm that the best results are obtained by gradually increasing the amount of ammonia), and in such case there would be no gain by adding fresh ammonia for an under-exposure—the mischief would be already done past repair. Again, as to restrainers: for their action to be of any avail they must be used early, and clearly, in the method we are describing, an over-exposed picture would be lost: it could not be dense enough in the time. But it is at the same time quite true that the less development an over-exposed plate has, the better condition it is in for after intensification with mercury. An over-exposed plate arrested at an early stage, and then intensified by mercury followed by sulphide of ammonium solution, will give an excellent negative when most other means would have given uselessly feeble results. We are sorry that we did not put the query to the gentleman whose operations we have been describing, as to his employment of mercury.

Finally, we may look at the mode of fixing. Many photographers consider it necessary to give plates a considerable amount of washing before putting them through this stage, but there is really nothing to advance in favor of the plan; while, on the other hand, all the time the negative is washing it is becoming more yellow in addition to increasing in density. We know of no reason for supposing that the introduction of "pyro" solution into the "hypo" bath will be conducive to the reproduction of fading negatives; and the advantages of the rapid fixing, especially with new hypo each time, was pointedly shown in the beautiful clean "wet-plate character" negatives we saw produced.

The subject when introduced was of such interest that we do not doubt it will be equally so to many of our readers. (We omitted to say that the plates we saw developed had been exposed some days before, so that there was no opportunity for fresh sittings in case of error.) We imagine that the general conclusion will be that the photographer in question was both skilful and lucky. In any case, if this narration of his experience should call forth descriptions of methods of developing by others, we shall be very pleased to have been the means of causing an addition to the general body of knowledge of the most valuable of all kinds—practical modes of manipulation.—*British Journal of Photography.*

PHOTOGRAPHY OF THE LEAST REFRANGIBLE PORTION OF THE SOLAR SPECTRUM.

From an advance proof from the "Proceedings of the American Academy." Communicated by the Author.

IT has been stated by eminent authorities that the process of staining dry plates with various dyes is not applicable to the photography of the invisible rays beyond the red of the solar spectrum. To test this question I have undertaken a series of experiments with the dye cyanine. This dye has of late come into considerable prominence in photography, owing to its orthochromatic effect when mixed with other dyes, such as chinoline-red, azaline, erythrosine and eosine.

It was discovered by Greville Williams, an Englishman, in 1861, but did not come into much prominence until the year 1884, when its usefulness as a sensitizer became more apparent. The dye is easily decomposed by light, and even in the dark both its solution and the plates coated with it are apt to become decomposed, if kept for any length of time. Alone, it has been found very useful to sensitize plates for the orange and red portions of the spectrum. No experiments have, to my knowledge, been made upon the effect of heat-rays upon cyanine plates.

The direct action of absorbents in the infra-red has not, hitherto, been tried with any success; moreover, it has been stated by so eminent an authority as Captain W. De W. Abney, that it was impossible to make plates sensitive to any rays below the A of the solar spectrum by means of the addition of dyes to a film. It is true, however, that Major Waterhouse has succeeded, by means of tumeric, in obtaining evidence of the existence of a few lines on the less refrangible side of A, but in all cases except one these were reversed.

The plates employed were made by the M. A. Seed Co. of sensitometer 22. The method used in staining the plates, and in the preparation of the dye, is substantially the same as that employed by J. B. B. Wellington, and is as follows.

Fifteen grains of cyanine are gently heated (over a steam bath) for from thirty to forty minutes in combination with one ounce of chloral hydrate and four ounces of water. The whole mixture should now be stirred vigorously. While this operation is going on, 120 grains of sulphite of quinine are dissolved by heat in a few ounces of methylated spirit. (If methylated spirit cannot be obtained, a solution of 90 per cent. alcohol and 10 per cent. wood spirits, will answer perfectly well.) One ounce of

strong aqua-ammonia is now slowly added to the cyanine mixture above. Violent ebullition takes place immediately, chloroform being evolved, and cyanine deposited in a soluble form on the sides of the vessel. The mixture is allowed to settle for a few minutes, and then the supernatant liquid is decanted off very slowly, care being taken not to detach any of the cyanine that formed on the sides.

To the remaining cyanine, three or four ounces of methylated spirit are added to dissolve it; the quinine solution is then added; and to the whole more methylated spirit, until the whole mixture measures from eight to nine ounces. This solution constitutes the "stock" solution, and should be kept away from all light, as it is very apt to become decomposed.

All of the above operations should be conducted in as little light as possible. The following staining and drying processes should be conducted in absolute darkness.

To thirty ounces of water are added 1½ drachms of the cyanine stock solution; the graduate that contained the cyanine is now washed out, 1½ drachms of strong aqua-ammonia are added, and the whole mixture is stirred vigorously. Into this bath two or three plates, or half a dozen strips, can be dipped at once. They should be left there about four minutes; meanwhile the tray containing the plates should be rocked continuously, so as to insure a uniform action of the dye.

This bath, after having been used once, should be thrown away, as the action of a second batch of plates would be weak and imperfect. The plates can now be drained, dried and used. While developing, I was careful to exclude all light whatever, although I think it possible that the plates may be developed safely in a dark greenish-yellow light. The developer used was a pyro and potash developer of (generally) normal strength.

In the first experiments the spectrum was produced by a Rowland flat diffraction-grating, mounted on a spectrometer-circle. This grating contained 17,000 lines to the inch. The observing telescope of the spectroscope was replaced by a camera and lens.

Certain photographs were also taken by means of a Rowland concave grating of 14,500 lines to the inch, and of 21 ft. 6 in. radius of curvature. With this grating, the amount of light being less and the dispersion greater than in the former cases, the exposure had to be increased.

In all the experiments ruby-red glass screens were used in order to cut out all of the more refrangible part of the underlying spectrum. In some cases a weak solution of iodine in carbon disulphide was used with good effect.

No difficulty was found in photographing from the A line to wave-length 9900, or to the limit assigned by Abney as the limit of the diffraction spectrum. None of the lines were reversed. A special study of the A group was made, photographs being taken at different seasons, in order to see if any changes in the remarkable group of lines constituting the A group could be noticed. No existing map represents this group correctly. Employing the second spectrum produced by a concave grating, 52 lines were observed between wave-lengths 7100 and 8000. In the same space Abney records only 24 lines. Between the head of A and the tail of A, the latter being the single line before the series of doublets begin which is so character-

istic of the A group, my photograph shows 17 lines. These photographs were taken in June, between ten and one o'clock.

These results are of special interest when we consider that Abney has said in a Bakerian lecture, "As a result of these experiments, I can confidently state that in no case did the addition of a dye cause any chemical effect to be produced by the rays below A of the solar spectrum, nor has Vogel claimed that they do."

It is interesting to note that Abney is led to believe that the photographic action which has been noticed hitherto, by the use of dyes as sensitizers, can be attributed to a certain action of nitrate of silver on organic matter. This effect is a bleaching one, and only the more fugitive dyes can produce it. We are led to conclude from Abney's paper that he believes that only a chemical effect produced in a specially prepared emulsion, can be used to produce the infra-red rays. After many experiments he succeeded in producing such an emulsion. The color of this verged upon the blue. Since the color of plates stained with cyanine by the process I have described is also blue, there may be some physical significance in this resemblance.

My experiments show that a specially prepared emulsion is not necessary for the photography of the infra-red region. The chemical theory advanced by Abney, therefore, seems to need revision.

J. C. B. BURBANK.

A NOTE ON HYDROQUINONE DEVELOPMENT, WITH ILLUSTRATIONS.

(*A Communication to the Newcastle-on-Tyne and Northern Counties Photographic Association.*)

FOR some time past considerable attention has been given to hydroquinone as a developing agent, and a large number of formulæ have appeared in the pages of the photographic journals.

In order to thoroughly test the merits of this re-agent I requested Mr. Green (operator for our firm) to make a collection of these published formulæ, to test them on various makers' plates, and carefully note the results. This series of experiments has taken up the spare time at his command for several weeks, and the results have proved extremely interesting and useful. Mr. Green has not been able to carry out these investigations sufficiently to enable him to state definitely the merits and demerits as between pyro and hydroquinone. The latter, however, proved in one direction to have a very marked advantage over pyro, and as this is somewhat important, and has special interest just now when taken in connection with an article which recently appeared in the *British Journal of Photography* on the keeping qualities of dry plates, I took the earliest opportunity of bringing the matter before you.

In the article alluded to, the writer calls attention to the trouble experienced by iridescent stain and fog. It is known to most of us that this surface fog is easily removed by the application of methylated spirit, but none of us care to have the trouble if we can avoid it. We found that plates which gave the surface with pyro and ammonia development showed not the slightest trace of it when developed with hydroquinone. I here exhibit a half-plate negative which was first exposed, then cut into two, one half being developed with pyro. This portion shows the iridescent

stain. The other portion was developed with hydroquinone, and is, as you see, quite free from it.

Hydroquinone appears also to have an equally marked advantage over pyro when used on plates which give a nasty, copper-colored fog in the film, as you will see from the negatives before you.

In the various formulæ for development with hydroquinone which have appeared in the photographic journals, there has existed one serious objection to its adoption by the busy photographer, viz., the extreme tardiness of development. With the appended formulæ the average time of development for a properly exposed plate is from two and a half to three minutes. In a correctly exposed "Mawson" plate the high lights begin to appear in about thirty-five to forty seconds, and then the first appearance of the image is rather deceptive, showing, as it lies in the tray, every indication of a harsh, under-exposed negative; but this gradually disappears and development proceeds more rapidly towards completion.

It is a more agreeable developer to work with than pyro and ammonia, can be modified to give any degree of density, or to bring out detail in cases of under-exposure and instantaneous work, and possesses some advantages over the latter, such as freedom from surface fog, green fog in its various forms, and, not the least important, in the substitution of caustic potash for ammonia we have an alkali of a much less variable nature to deal with.

Meta-bisulphate of potassium, the best known preservative of pyrogallic acid, promises to be equally efficacious in preserving hydroquinone. A sample we have had in solution for six weeks shows no sign of deterioration.

I.

Hydroquinone,	4 grains.
Meta-bisulphate of potassium,	4 grains.
Bromide of potash,	1 grain.
Distilled Water,	1 ounce.

II.

Potassium hydrate (stick),	10 grains.
Distilled water,	1 ounce.

Equal parts of 1 and 2.

J. B. PAYNE.

SELECTIVE ABSORPTION OF METALS FOR ULTRA VIOLET LIGHT.

(*Proceedings of American Academy.*)

THE question of the absorption of the ultra violet rays by metallic surfaces possesses considerable interest, both from a practical and a theoretical point of view. By the kindness of Prof. Pickering, director of the Harvard University observatory, we were provided with a number of metallic surfaces prepared by Prof. Wright, of Yale College. These metallic surfaces were deposited upon glass by means of electricity. The surfaces were of gold, platinum, tellurium, palladium,

copper, silver and steel. A preliminary trial had shown us that a heliostat mirror of the same composition as that upon which the grating was ruled, did not absorb light of greater wave length than 2900. We resolved therefore to compare other metals with speculum metal. Since our heliostat arrangement required two mirrors to direct the light upon the slit of the spectroscope, we employed a speculum mirror for the movable mirror of the heliostat, and replaced the fixed mirror by mirrors of metal, whose selective absorption we wished to compare with that of speculum metal. To our surprise the metallic mirrors of gold, copper, nickel, steel, silver, tellurium and palladium all reached the same limit as speculum metal.

Here was a complete experimental proof that color in no way influences the selective absorption of metals for the ultra violet rays; for the copper mirror, which gave a strong yellow light by reflection, was capable of reflecting light of as short wave length as the brilliant white surface of polished silver. Although the metallic surfaces we employed were bright, slight differences in polish no doubt existed, and therefore we are not justified in placing much reliance upon the evidence presented by the intensity of the photographs of the solar spectrum obtained by light reflected into the spectroscope by these various metallic surfaces. The photographs, however, can be classified according to intensity in order of numbers as follows, 1 indicating the greatest intensity: 1. Steel; 2. Gold; 3. Platinum; 4. Palladium; 5. Silver; 6. Tellurium; 7. Copper. It was evident from these experiments that selective absorption of metals is far less than the absorption exercised by the earth's atmosphere. We resolved therefore to employ the light of the electric spark between metallic terminals, in order to ascertain whether any limit of absorption could be reached.

For this purpose the light of the spark between copper terminals was reflected by means of a mirror of the metal whose selective absorption we wished to examine, upon the slit of the spectroscope. To protect the surface of the mirror from the effects of the spark, a thin plate of quartz was placed in front of it. It was found that the copper mirror showed no limits of selective absorption by reflection for wave lengths of light produced by burning copper at the limits of the copper spectrum, that is, wave length of 2100.

The photographic plate taken by this method showed all the lines that the plates showed which were taken by the direct light of the spark, unreflected and unabsorbed by any medium. The palladium mirror was substituted for the copper mirror, and also showed no limit of selective absorption above wave length, 2100.

We are led to conclude therefore that the metallic surface of the speculum metal upon which the lines are ruled which form the diffraction grating does not fix by selective absorption the limit of metallic spectra at 1800 to 2000. This limit more likely resides in the materials forming the sensitive emulsions with which the sensitive plates are coated. We have found that a marked difference exists in different emulsions in regard to sensitiveness to ultra violet light. The various staining processes which enhance, to such a marked degree, the sensitiveness of photographic plates to wave lengths of greater length, do not seem to affect the limit of metallic spectra in the ultra violet. Thus plates stained with erythrosine which are extremely sensitive to yellow and green light, continue to give the same limit in the ultra violet after staining as they did before they were submitted to the staining process.

JOHN TROWBRIDGE and W. C. SABINE.

PHOTOGRAPHING SNOW SCENES.

TO the poet and painter a landscape at that time of year

> "When yellow leaves or none or few do hang
> Upon those boughs which shake against the cold."

may be rich in suggestion of thought and sentiment; to the one "summoning up remembrances of things past," to the other suggesting a theme for broad and effective handling of masses of light and shade, and glorious harmonies of color; but to the photographer bare boughs are unsightly in themselves and unprofitable for pictorial rendering.

But when clad with their winter foliage of soft, fleecy snow they are made so beautiful, and the whole landscape is so transfigured, that many a camera is lured forth from its hibernation, and the enthusiastic amateur wades through drifts to secure a tempting bit.

There are certain conditions necessary by which these fairy scenes of the inverted year can be caught in all their beauty. Much depends upon exposure, much more on development.

In our climate the soft mask of new fallen snow is soon obliterated, and the ambitious photographer will find that unless he starts out early the sun will get ahead of him, and despoil the woods of the special endowment of Boreas.

The first great precaution is to be sure that no extraneous light gets into the camera by improper reflection from brass work, etc., for the light reflected from the snow and ice is very brilliant; and should any stray beams enter, the plate would be fogged.

Throw the focusing cloth over the holder before drawing the slide. Also be sure that the tripod rests firmly upon solid bottom and not upon a fictitious crust of ice.

A snow or ice scene is only effective when the contrasts are properly balanced; the great danger of harshness arises from the high lights being so brilliant and the shadows so deep cast. This is especially the case when the sun illuminates the masses.

We must select the proper angle of illumination, so that the prominent portions cast shadows upon the level parts of the snow or ice. A slightly overcast day, for this reason, yields much better results; the light from the snow clouds in the sky is really dazzling, as any one can prove by looking steadily at it for a few minutes.

Moderate size masses of snow and ice, in themselves, often form beautiful pictures. When no object of comparison is near by to judge of the actual dimensions of the mass, the effect is enchantingly deceptive, the innumerable grottoes and stalactites of icicles giving the appearance of caverns with endless windings in which one might imagine gnomes and elves to wander.

Then, too, rocks covered with ice and icicles are most beautiful in the contrast of the rough and smooth, the dark and the glittering.

Over-toning is apt to be the besetting sin of the snow photographer. One can hardly believe in the quantity of light reflected from the surface of snow. We all know how easy it is to find our way, even on the darkest night, when the fields are covered with snow.

Slight over-timing, however, is far preferable to under-timing with snow pictures. We can, in a measure, remedy too strong an action of light, but there is no photographic therapeutic for insufficient exposures.

Endeavor to get as near as possible the correct exposure. This is not difficult if you have a little experience and are thoroughly acquainted with your plate and lens. Of course, no direct rule for exposure can be given, inasmuch as even snow scenes vary much in variety and character.

Supposing you have given ample time, the following hint in development will be found useful.

A strong, vigorous development never gives as good results with snow scenes as a soft, slow action of the chemicals. The alkali should be in slight excess so as to keep down violent contrasts, and the quantity of water increased at once if the action is found to proceed too rapidly. By this means the shadows have an opportunity to accumulate some of the particles and are consequently made richer thereby in detail. However, flatness must be avoided, and the judgment must be called constantly into exercise if one is anxious for beautiful results. The negative should be frequently looked through to see if the high lights are having the necessary vigor. If the shadows have built up, then add a little more pyro if the high lights are tardy in gaining strength.

THE PHOTOGRAPHIC SOCIETY OF PHILADELPHIA.

A STATED meeting of the Society was held Wednesday evening, November 7th, 1888, with Vice-President John G. Bullock in the chair.

The Committee on Membership reported the election of Mr. William Elliot Barrows as an active member.

Mr. William H. Rau, director, representing the Society in the American Lantern Slide Interchange, reported that the Society's quota of slides had been sent to the Executive Committee, who had selected therefrom 97, which would be sent on the circuit of the various organizations connected with the Interchange. The slides from the Society of Amateur Photographers of New York would be shown at the Conversational Meeting, November 21st.

The Executive Committee of the Interchange had selected, from the slides for 1886–7, two hundred to be sent to England in exchange for the same number to be sent to this country. Fifty-seven of the slides selected for this purpose were the work of fourteen members of this Society.

In pursuance of the resolution passed at the last meeting, the chair appointed Messrs. Geo. B. Wood, John Carbutt, Sr. and David J. Hoopes a Committee to collect portraits and autographs of members of the Society, to be preserved in an album provided for the purpose.

Mr. Stirling offered a resolution amending the By-Laws so as to provide for a Committee on Lantern Slides to be elected annually, who shall have charge of the lantern slides belonging to the Society, and other matters connected therewith. The amendments will be acted upon at the December meeting.

Mr. Browne presented to the library of the Society copies of "A Manual of

Photography," by George B. Coale, and "A Guide to Photography," by W. H. Thornthwaite, which were accepted with a vote of thanks.

Mr. Stirling made the announcement that, on behalf of Mr. George W. Childs, the pleasant duty devolved upon him of presenting to the Society a set of the Muybridge plates illustrating animal motion, reproduced from the instantaneous photographs recently made under the auspices of the University of Pennsylvania.

In making the presentation, Mr. Stirling referred to the great scientific and artistic value of the work, and said it had been Mr. Childs' desire that this copy of it should be in the hands of some permanent organization to which it would be of value. In the Photographic Society Mr. Childs recognized such a body, both by reason of the scientific nature of its objects, and the artistic character of its work. In conveying the plates to its care, he expressed a hearty wish for its long-continued usefulness and prosperity.

The presentation was received with enthusiastic applause, and a vote of thanks was extended to Mr. Childs for his valuable gift.

Mr. Carbutt showed his new Flexible Negative Film, intended as a substitute for both glass and paper negatives. The films are but one one-hundredth of an inch in thickness, and can be printed from either side. They weigh about the same as paper, or about one-twelfth as much as glass. They can be used in any ordinary plate holder, or in special thin holders made for the purpose. The manipulation of exposing, developing, fixing, washing, etc., are performed exactly as with glass plates. The difficulties and inconveniences of paper negatives and stripping films are entirely avoided. Mr. Carbutt also showed a holder devised to carry twenty-four films. By use of a changing bag, after exposure each film was removed from the front to the back of the holder, a fresh film being brought into position ready for the next exposure.

Mr. Bartlett presented to the Society, on behalf of Mr. McCollin, an improved Ignitor for use with flash-light compounds, of compact and convenient form. He also brought to the attention of the members an improvement in mercurial intensification of negatives. When, after bleaching with bi-chloride of mercury, a solution of sulphite of soda is used, if left too long in the second solution the negative becomes reduced in density. If the sulphite of soda solution, which is usually alkaline, is rendered neutral with sulphuric or other acid, this reduction will be prevented, and the intensification will continue to the point desired with an improvement in color.

Mr. Suplee called attention to a report, lately published in the London journal, *Engineering*, of a discussion of the Physical Section of the British Association for the Advancement of Science, at the meeting recently held at Bath. But for the distinguished body before whom the matter was brought, and the serious manner in which it had been treated, the report would seem like a fairy tale and not worthy of consideration. It read as follows:

"Mr. Friese Greene's paper 'On a Photographic Image of an Electric Arc Lamp probably due to Phosphorescence in the Eye,' is a contribution of singular interest. Mr. Friese Greene actually exposed a sensitive plate to the light issuing from his eye, and photographed with it. He stared at a 3000-candle arc lamp in Piccadilly, at a distance of 3 feet only, for 15 seconds, closed his eye and brought it rapidly over the sensitive plate within one inch distance from the film. Thus he obtained a very

faint yet distinct image of the arc, the two carbons, the image of the arc and the reflector, and also a faint indication of the cone. A second attempt failed. The arc probably produced a bright spot on the retina, which remained luminous for a moment after the lamp had been shut off. One remarkable circumstance of this novel mode of photographing was pointed out by Mr. Shaw: 'The image is in focus, so that the focus of the eye must have changed most rapidly.' Several speakers would have liked to suggest a continuation of these experiments with a weaker source of light, less deleterious to the eye; but Mr. Greene had failed to obtain any effect with gas lights."

Mr. James Wilson showed a lens mounted in aluminium instead of brass, reducing the weight two-thirds. He also showed a lens fitted with Bausch & Lamb's Iris Diaphragm Shutter for time and instantaneous exposures.

Mr. Truscott, a visitor, showed a lens fitted with an adjustable mount, which enabled the glasses to be brought more or less close together, thereby changing the angle of view. A lens by Steinheil of 3 inch focus and extreme wide angle was shown. The lens would certainly cover a 6½ x 8½ inch plate and probably 8 x 10. He also exhibited one of Steinheil's Group Anti-Planetic Lenses, No. 2 series, an extremely rapid lens, as testified by some excellent prints of a base ball field with the players in most rapid motion.

Adjourned.

ROBERT S. REDFIELD,
Secretary.

PLATINOTYPE.

AT the October meeting of the London Camera Club, Mr. F. de Paula Cembrano gave an interesting account of his experience in the platinotype process, for an abstract of which, and the discussion of the members of the club, we are indebted to the *British Journal of Photography* of October 19.

Mr. Cembrano, in treating his subject, commenced with a general description of the platinotype process, and gave an outline of each of the methods now introduced. He had conducted a very extensive series of experiments to compare the results obtained from different preparations of the printing-out paper, and also from the ordinary hot process and the new cold bath process. For these purposes he had employed consistently eight negatives. These, and a very large number of prints from them, mounted upon cards in sets for convenience of comparison, were handed round. In regard to the cold bath process, he found it gave very brilliant prints, with less softness, perhaps, than the hot process, but with very vigorous blacks. He thought it would be specially serviceable for the reproduction of engravings where a powerful black was required. He had not found himself able to control the development as he had seen done by Mr. Willis. In reference to the Pizzighelli paper, he had first used the commercial paper, but had found it fail somewhat in giving detail in deep shadows.

Mr. Cembrano then sensitized a sheet of paper with a modification of the Pizzighelli formula, and handed round sets of prints showing the results obtained by various formulæ he had employed. These formulæ were given in the lecture, one of them including the addition of chloride of calcium to the sensitizer.

In the discussion, Mr. Wellington said he had experimented upon the No. 3 formula as given by Pizzighelli, making variations in it. The conclusion he had arrived at was that the best results were obtained when he added sugar to the gum used in preparing the paper. Some excellent examples of this method of preparation were shown. He was glad to see that Mr. Cembrano had shown good prints upon paper prepared with chloride of calcium in the sensitizer. It had occurred to him that a hygroscopic substance mixed in the sensitizer might prove beneficial.

Mr. Guardia thought gum gave a granular appearance. He preferred sized paper. He did not think the printing-out paper often gave the results of the old process; in fact, he inclined to think no process did.

Mr. Stroh could never get Pizzighelli paper twice alike. One lot would give excellent results, the next batch streaky and not at all black. If different kinds were manufactured, then they ought to be distinguished by the vendors as A, B, and so on. If it could be made perfect, it would be a lovely process. He had found it rather useful for panorama subjects, where the printing of the separate sections of the picture had to be of the same depth. Contrary to what was generally stated, he pointed out that the paper did really print, although perfectly dry. The color given was different from where it had absorbed moisture. Several examples were shown by Mr. Stroh to illustrate his remarks.

Mr. Cowan found he obtained a very vigorous print with the commercial paper.

Mr. Lyonel Clark gave the results of an extensive set of experiments he had conducted upon the different process papers with the sensitometer, and showed the curves obtained thereby; the general conclusion arrived at being that the Pizzighelli method of preparation gave the least range, and the new cold bath process the greatest. To get a decent print from Pizzighelli paper, he stated that a very dense, hard negative must be used.

Mr. Rodgers had obtained good results with thin negatives, and had found much advantage accrue from the use of old acid baths. There was more detail in the shadows, he considered, than with the hot process.

Mr. Davison was afraid a velvety black could never be obtained upon the printing-out paper. He had found it give good prints from thin negatives if the paper was dry and new, although the color was not black. It could only be allowable to breathe on the paper from printing very hard negatives. He showed some examples of solarisation on the paper, where a burnt-up appearance was the result. He had not found, as stated, that there was any reduction of the density of the negative where *breathed-on* paper had been long in contact with the film. Of all the processes he had tried, he preferred the new cold bath process The image was on the surface of the paper instead of being sunk in the paper, and consequently greater brilliancy and detail were given. There was very little difficulty in judging the printing, which was quicker. The point he felt of the most importance was that a *brilliant* and a half-tone paper could be supplied, one suited to thin and the other to denser negatives. The developer should not be too dilute, or granularity appeared to result. The great objection, he felt, which would be raised against the process was the cost, unless some means could be devised of economizing in the use of the developer.

Mr. Willis said he rather preferred to listen to the opinions of others in regard to

any new process than to express his own. He might say that wherever the image was *printed* out in the old platinum process (the hot process), the result was inferior to that in which it was *developed* out. Further: after printing to a certain depth, the platinum deposit was so opaque in printing-out methods that the action of light in the shadows soon ceased. In regard to printing-in clouds in platinum, he gave the experience of a good worker that it was best to print the clouds in before the landcape, as there was less risk of fogging the horizon line. Referring to the cold bath process, he stated that warmer tones could be obtained by exposing for half an hour to the atmosphere.

Mr. Cembrano having replied, the chairman closed the discussion, and a vote of thanks was passed to Mr. Cembrano for his careful and complete paper and series of experiments.

In illustration of the subject of the evening, an interesting set of pictures by Mr. Seyton Scott was shown, in which all the processes were well compared, and the variation in color obtainable on Pizzighelli paper exemplified. Some fine prints lent by Mr. Rudowski were also exhibited.

EDITORIAL NOTES.

TWO accidents have recently resulted from the careless handling of magnesium flash powders,—one of them terminating fatally, the other in serious injuries.

John Cruise, of Philadelphia, aged sixteen years, while mixing a large quantity of the powder, commercially known as Violet Flash, was so severely burned by a premature explosion of the powder that he died from the effects. The jury brought in a verdict of death from burns accidently received, the coroner telling the jury that it was evident that all care and precaution had been observed by the manufacturers of the powder, and that the accident was solely due to improper handling of the material by the lad.

The other accident, which fortunately did not result in the death of the reckless handler, occurred in San Francisco. A youth aged 18, in the employ of Sam. C. Partridge, in an idle moment foolishly loaded with eight full charges of Blitz-pulver a frail piece of apparatus known as the Hawkridge pistol, intended merely to burn metallic magnesium powder in an alcohol flame, and not at all designed by the inventor for any kind of flash powder. As might have been anticipated an explosion of the pistol followed, and a fragment of the metal was lodged in the skull of the unfortunate boy. Several of his fingers also were severely injured.

Mr. Partridge, in a letter addressed to the manufacturer of Blitz-pulver, says: "I do not wish anything to be published in regard to the powder which might injure its sale, but think that all should be cautioned in regard to its use, and would suggest, for the safety of consumers, and those likely to come in contact with it, that in future lots of the powder sent out should have printed on the wrappers, 'Caution. Never to be ignited when confined in a pistol,' etc., etc."

It is proverbial that there is a special providence for fools and children, or else the proportion of accidents from presumption and folly would be much greater. In both

of the cases mentioned the sufferers were mere lads, and are excusable on the plea of immaturity; in one case ignorance being the cause of the disaster, in the other, want of intelligence.

It would have been a miracle if the firing of eight charges of powder in a frail pistol had not caused damage. The unfortunate youth of San Francisco belongs to the class of presumptuous and fool-hardy people who imagine they are exempt from the penalties attending the kindling of fires with kerosene, and yet it is not thought necessary to label every coal-oil can with the caution not to use it in kindling the kitchen fire.

The manufacturers of flash powder supply apparatus and give full instructions for properly using the powder, and which every person of average intelligence follows without any risk of injury. Any material, however safe from spontaneous combustion or from ignition from friction, if compressed in very confined limits, will, on ignition, exert great pressure upon the containing walls, by the formation of gases, and if these walls are not stout enough to resist the forces of expansion, they will be shattered, and carry destruction in their path. It would be too much strain to expect a regulation tested musket to resist eight charges of powder at once. Ordinary air, when under great pressure, becomes quite as dangerous as any flash powder.

We greatly deplore the unfortunate consequences of these presumptuous experimenters, and do hope that in future a little commodity of common sense will be used, when flash powders are employed.

"AMERICAN ART" is the title of a new publication devoted to the study of the progress of painting and kindred arts in the United States. The number received is a most excellent specimen, being well illustrated with choice selections from the works of prominent artists. The reading matter is interesting, being made up of contributions from a number of writers of merit and taste. The publication deserves a liberal support, especially as the price is so reasonable. Published by American Art Magazine Co., 110 Tremont Street, Boston, Mass.

AT the last meeting of the Photographic Society of Philadelphia, Mr. John Carbutt showed his new flexible negative films, a substitute for glass plates.

The films are less than one one-hundredth of an inch in thickness; so that it would require a great many to weigh as much as a single plate of glass of the same dimensions.

The advantages claimed for them are their lightness, flexibility, and the ease with which they can be worked, no stripping whatever being required. The sensitive films being directly upon a thin, flexible substratum of celluloid, may be handled just as readily as a glass plate, with the advantage that several may be developed with the one operation. The resultant negatives, which Mr. Carbutt exhibited, were remarkably fine, possessing all the virtues of a beautiful glass negative. There is not the slightest indication of grain or opaque spots. Any degree of density may be secured, and the emulsion may be obtained of any sensitiveness desired.

Mr. Carbutt showed prints from the glass negatives and the film negatives exposed on the same subject, in which it was impossible to discover any difference.

We congratulate Mr. Carbutt for his skill in producing such an excellent substitute for the heavy, bulky and easily broken glass plate, which the amateur has hitherto been obliged to carry upon his journeys.

These films will be very popular, on account of the ease with which the development may be effected. They are made of all sizes, and may be exposed in holders similar to the Daisy holder. Special holders are being made, in which a number of films may be held and successively exposed.

MODIFICATION OF THE MERCURY INTENSIFIER.—The mercury intensifier, composed of bi-chloride of mercury, bromide of potassium and water, is now generally followed by sulphite of soda solution instead of ammonia, on account of the better color secured, and the better printing quality of the negative. Caution, however, must be used in the application of the sulphite of soda. The negative must be removed, we are told, as soon as the blacking is complete, otherwise a reducing action sets in, and the negative will suffer in the half tones. While the dense portions of the drapery are blacking through to the reverse side of the plate, we frequently find that the fine gradations in the face are obliterated, hence the caution to lift out the plate immediately after the action is complete. It will be found that the addition of a few drops of acid, sulphuric, acetic or citric, added to the sulphite solution so as to make it neutral, entirely prevents the reducing action, and the negative may be allowed to lie any length of time in the solution. We believe this simple modification will be found of great advantage in intensification, as the sulphite is far preferable to ammonia.

LUMINESCENCE OF PYROGALLOL.—The authors, P. Lenard and M. Wolf, without knowing of the similar observations previously made by Eder, observed that a photographic plate after development with an Eder potash developing solution, or with a soda developer after previous washing with a solution of alum, becomes distinctly luminous, and remains so for a couple of minutes or so. The phenomenon appeared to them to be of sufficient interest to call for further investigation, and a number of experiments, made with a view of determining the origin of the luminosity, are described in the paper (*Ann. Phys. Chem.* [2.], 34, 918.)

As the phenomenon was found not to be a case of true phosphorescence, they call it "luminescence."

From their investigation, they arrived at the conclusion that the phenomenon is due to both pyrogallol and oxygen being condensed on the surface of the freshly precipitated alumina, resulting in rapid oxidation. In general the luminosity was not observed when sodium sulphate was not present, but they found that a feeble luminescence could even then be produced by saturating potassium pyrogallol with pure oxygen, and then adding a solution of alum. From this and other experiments they conclude that the part played by the sodium sulphate is to delay the oxidation until the pyrogallol and oxygen have been brought into close contact, in the pores of the precipitated alumina.—*G. W. T. in Journal of Chemical Society.*

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